CRITERION 420

STEAM TRAPS

SIGNATURES

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CRITERION 420
STEAM TRAPS

1.0 PURPOSE

The purpose of this Criterion is to establish the minimum requirements and best practices for operation and maintenance of steam traps at LANL.

This document addresses the requirements of LIR 230-05-01(Ref 10.1), "Operations and Maintenance Manual."

Implementation of this Criterion satisfies DOE Order 430.1A (Ref 10.2) for the subject equipment / system. DOE Order 430.1A (Ref 10.2)"Life Cycle Asset Management," Attachment 2 "Contractor Requirements Document," Paragraph 2, Sections A through C, which in part requires UC to "…maintain physical assets in a condition suitable for their intended purpose," and employ "preventive, predictive, and corrective maintenance to ensure physical asset availability for planned use and/or proper disposition." Compliance with DOE Order 430.1A is required by Appendix G of the UC Contract.

2.0 SCOPE

The scope of this Criterion includes routine inspection, testing and maintenance of the over 5000 steam traps in LANL facilities. Pressure relief valves are address in O & M Criterion 419, "Inspections and Testing of Pressure Vessels and Pressure Relief Valves". Pressure reducing Valves (PRVs) will be included in a valve criterion.

3.0 ACRONYMS AND DEFINITIONS

3.1 Acronyms

AHJ	Authority Having Jurisdiction
CFR	Code of Federal Regulations
DOE	Department of Energy
LIG	Laboratory Implementing Guidance
LIR	Laboratory Implementing Requirement
LPR	Laboratory Performance Requirement
O&M	Operations and Maintenance
PPE	Personal Protective Equipment
PP&PE	Personal Property and Programmatic Equipment

PRV	Pressure Reducing Valves
RP&IE	Real Property and Installed Equipment
SSC	Structures, Systems, and Components
UC	University of California

3.2 Definitions

Condensate. Steam that has lost its heat to any surface at a lower temperature and has condensed into water.

Drip Leg. A section of pipe in the lower part of the steam piping system used for the collection of condensate. Condensate is returned to the steam generating system with the use of traps and other valves. Mud and debris are also collected in lower end of drip leg.

Pressure Reducing Valve (PRV). A pressure reducing valve is an automatic pressure regulating device, which maintains downstream pressure at a preset value, which is lower than the upstream source.

Steam. Water in its gaseous state.

Steam Trap. A self-activating valve that remains closed in the presence of process steam but opens to discharge non-condensable gases (mostly air) and condensate. This selective purging maintains high heat-transfer coefficients in equipment without losing steam pressure.

Basic Types of Traps:

- **Thermostatic (balanced pressure, bimetallic, liquid expansion)**
  Operate on basis that steam is hotter than condensate or steam contaminated with non-condensable gases.
- **Mechanical (Float and thermostatic, inverted bucket)**
  Operate on density difference between steam and condensate.
- **Thermodynamic (disc)**
  Operate on release of flash steam to close condensate discharge valve.

Strainer. Strainers are used to remove rust and scale from the condensate to protect the traps and valves.

Water Hammer. Water hammer occurs when a slug of water pushed by steam pressure along a pipe (instead of draining away at the low points) is suddenly stopped by the impact on a valve or fitting such as a pipe or tee. The velocities, which such slugs of water can achieve, can be much higher than the normal steam velocity in the pipe, especially when the water hammer is occurring at the start up of a cold steam system.

4.0 RESPONSIBILITIES

4.1 FWO-Maintenance and Systems Engineering (MSE)

4.1.1 FWO-MSE is responsible for the technical content of this Criterion and monitoring the applicability and the implementation status of this Criteria and either assisting the organizations that are not applying or meeting the implementation expectations contained herein or elevating their concerns to the director(s).

Basis: LIR 301-00-01.11; Issuing and Managing Laboratory Operations Implementation Requirements and Guidance, Section 5.4, OIC Implementation Requirements.

4.1.2 FWO-MSE shall provide technical assistance to support implementation of this Criterion.

4.2 Facility Manager

4.2.1 Responsible for operations and maintenance of institutional, or Real Property and Installed Equipment (RP&IE) under their jurisdiction, in accordance with the requirements of this document.

4.2.2 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document that may be assigned to the FM in accordance with the FMU-specific Facility/Tenant Agreement.

4.3 Group Leader

4.3.1 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document, which are under their jurisdiction.

4.3.2 Responsible for system performance analysis and subsequent replacement or refurbishment of assigned PP&PE.

4.4 Authority Having Jurisdiction (AHJ) - POC for Mechanical Chapter of LANL Engineering Manual

4.4.1 The AHJ is responsible for providing a decision on a specific technical question regarding national, state and local codes and DOE orders.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Precautions

This section is not intended to identify all applicable precautions necessary for implementation of this Criterion. A compilation of all applicable precautions shall be contained in the implementing procedure(s) or work control authorization documents. The following precautions are intended only to assist the author of a procedure or work control document in the identification of hazards/precautions that may not be immediately obvious.

5.1.1 Steam systems present hazards from temperature and pressure. Improper operation or start up can result in costly damage and injuries. Only trained knowledgeable personnel should be allowed to operate, inspect, or maintain steam systems.

5.1.2 Water hammer, the unexpected release and associated shock wave of high-pressure steam/condensate, can cause death, severe injury, and extensive property damage. In one such case, a water hammer filled a confined space with 120 psi steam on June 7, 1993, killing the Hanford site power operator who opened the valve. Although direct clean-up costs totaled only $34,000, the costs necessary to upgrade systems including inspection, component replacement, procedure revision, labeling and drawing, and to implement adequate conduct of operations, exceeded $5 million dollars.

Basis: DOE/EH – 0437

The following Precautions are derived from DOE Lessons Learned Workshops on Water Hammer Incidents.

1. Review and inspect all steam systems to ensure proper distribution and sizing of cold traps for startup and operation, and to verify that all low points have steam traps. Give maintenance the highest priority.
2. Frequently inspect all steam traps to ensure that they operate properly and that no condensate accumulates. Immediately repair or replace erratic steam traps. Use thermocouples where feasible to locate condensate accumulation.
3. Do not "CRACK OPEN" valves to avoid condensation-induced water hammer. This will not guarantee safe operation. The formation of a condensation-induced water slug can occur at very low condensate flow conditions.
4. Valves in pipe lines that lack properly positioned steam traps should remain open at all times or, preferably, should be removed from the piping system.
5. Where feasible, operate the valves remotely using mechanical extension linkage; reach rods, or adequately controllable power-operated valves.
6. Inspect the piping system for sagging. Where necessary, install steam traps or repair the sagging.
7. Check or repair the piping insulation. It will save energy and reduce accumulation of condensate in the piping system.

8. Activation of cold steam piping should be performed slowly at reduced pressure and with trap bleed valves continuously open.

   Note: Use steam condensate warm-up load formulas for larger systems (2 inch and above) which bypass traps on startup. (See Appendix A)

9. The above list of recommendations should be followed regardless of piping size. Do not exclude small pipe sizes without appropriate analysis.
10. All isolation valves must have bypass systems. However, bypass operation will not prevent water hammer if condensate is present.
11. Placement of blowdown valves before and after a vertical rise (such as over-the-road) is required to prevent possible condensate accumulation.
12. Improperly designed steam/water systems should not have the incorrect features overcome by operational methods. Systems must have incorrect features corrected.

5.2 Limitations

The intent of this Criterion is to identify the minimum generic requirements and recommendations for SSC operation and maintenance across the Laboratory. Each user is responsible for the identification and implementation of additional facility specific requirements and recommendations based on their authorization basis and unique equipment and conditions, (e.g., equipment history, manufacturer warranties, operating environment, vendor O&M requirements and guidance, etc.).

Nuclear facilities and moderate to high hazard non-nuclear facilities will typically have additional facility-specific requirements beyond those presented in this Criterion. Nuclear facilities shall implement the requirements of DOE Order 433.1 (Ref. 10.3) (or 10 CFR 830.340, Maintenance Management, when issued) as the minimum programmatic requirements for a maintenance program. Additional requirements and recommendations for SSC operation and maintenance may be necessary to fully comply with the current DOE Order or CFR identified above.

6.0 REQUIREMENTS

Minimum requirements that Criterion users shall follow are specified in this section. Requested variances to these requirements shall be prepared and submitted to FWO-MSE in accordance with LIR 301-00-02 (Ref. 10.4), “Variances and Exceptions to Laboratory Operations Requirements,” for review and approval. The Criterion users are responsible for analysis of operational performance and SSC replacement or refurbishment based on this analysis. Laws, codes, contractual requirements, engineering judgement, safety matters, and operations and maintenance experience drive the requirements contained in this section.

6.1 Operations Requirements

No Operational Requirements for Steam Traps. As part of a pressure system, steam distribution system must be operated in accordance with requirements identified in O & M Criterion 419, "Inspections and Testing of Pressure Vessels and Pressure Relief Valves".

6.2 Maintenance Requirements

No specific requirements for maintenance of steam traps in this criterion. LIR 230-04-01.1, Laboratory Maintenance Management Program, Section 6.1.1 requires an inventory (MEL) of all equipment needing maintenance

7.0 RECOMMENDATIONS AND GOOD PRACTICES

The information provided in this section is recommended based on acceptable industry practices and should be implemented by each user based on his/her unique application and operating history of the subject systems/equipment.

7.1 Operations Recommendations

None

7.2 Maintenance Recommendations

7.2.1 Steam Trap Testing

Steam traps are not maintenance free. A systematic program of testing and maintenance is necessary for efficient operation. Problems are caused when a trap fails opened or closed. In one instance costly steam is wasted, in the other mode condensate backs up resulting in potential damage. Most traps fail in the open mode. At minimum, traps should be tested annually.

Trap testing is not simple. The following methods can be utilized:

- Observation of condensate discharging from trap. Test Tee's are usually employed and the individual performing the observation should be able to differentiate between flash steam and live steam. Flash steam is the lazy vapor that forms when hot condensate is discharged from a steam trap to the atmosphere. The presence of flash steam is natural and does not imp1y waste steam or trap failure. If the mixture of condensate and flash steam is being discharged several times a minute as the trap cycles, the trap is operating properly. If the trap discharges live steam, (can be seen with a test valve), the trap is faulty.

- Listening to traps as they operate. Listening can be enhanced with the aid of an industrial stethoscope (or steel rod, screw driver). Ultrasonic instruments can also be employed.
- Traps have a temperature differential between the upstream and downstream sides of a proper functioning trap. Measuring the temperature differential (and upstream pressure) can determine whether a trap is functioning properly. Use a contact pyrometer or other accurate temperature-sensing device. It is usually more economical to replace a trap with a new or rebuilt unit than to perform a field repair. Damaged or malfunctioning traps can be rebuilt in a shop if scheduling allows shop time.
- Water Hammer can be an indicator that a trap is not working or is installed in a wrong location.
- A steady discharge of steam and water vapor at the steam trap vent line is another indication a trap is not working.

Basis: LANL Engineering Experience; Spirax Sarco Steam Utilization Guide

7.2.2 Trap Maintenance

- Since traps are installed at the low point in the system, they trap dirt and line scale and should be cleaned at least once every two years.
- Line strainers should be blown down at least once per year.
- In addition to testing and cleaning, trap maintenance will consist of replacing broken or worn parts. Manufacturers' instructions and recommendations should be obtained and followed for these repairs.

8.0 GUIDANCE

8.1 Operations Guidance

8.1.1 Manufacturers Handbook such as "Steam Utilization" by Spirax Sarco is good sources for operational guidance.

8.1.2 Steam traps

One of the most important elements in a steam system in terms of performance and safety is the steam trap. A steam trap is essentially a self-actuated valve that is used to remove condensate and noncondensible gases from a steam system. When operating properly, the trap will open in the presence of condensate, regardless of temperature, and allow the condensate to pass out of the system, but close before steam escapes.

The proper operation of steam traps is essential to the safe and efficient operation of the steam system. Applications that use steam require that the steam be free of moisture. Wet steam (steam that contains moisture condensed from the steam) reduces the heat capacity of the line and equipment connected to as the condensed moisture heat content is much less than that of the same mass of steam.

Wet steam can also be destructive. Steam velocities, particularly in large systems, can range as high as 6,000 feet per minute. If the steam is wet, the moisture tends to settle in the bottom of the steam line where it is pushed along by the rapidly moving steam. The action of the steam passing over the condensed moisture results in the formation of ripples in the condensate. These ripples grow, forming waves. Given slug of condensate that completely fills the steam line. Moving at the same velocity as the steam, the slug of condensate can have enough momentum to damage obstructions, such as valves, joints, or even turns in the steam pipe.

In order to prevent the buildup of condensate within the steam system, steam traps are added to provide routes of escape for the condensate with confining the steam. To be effective, three conditions must be met: the proper type of trap must be selected; the trap must be correctly size for the load and application; and the trap must be maintained. Failure to meet any of these three conditions results in a system that either allows condensate to back up dangerously into the steam lines, *or* one that wastes energy by allowing steam to escape.

Basis: Spirax Sarco Steam Utilization Handbook, Federal Energy Management Program Newsletter (Ref. 7)

8.2 Maintenance Guidance

8.2.1 Steam Trap Trouble Shooting

Problem	Possible Cause/Cure
Trap does not discharge	1. Steam pressure too high, pressure regulating out of order, boiler pressure gage reads low, steam pressure raised without altering or adjusting trap. On the last item consult trap maker. He can supply parts for higher pressure or tell you how to adjust trap. 2. Plugged strainer, valve, or fitting ahead of trap; clean. 3. Internal parts of trap plugged with dirt or scale; take trap apart and clean. Fit strainer ahead of trap. 4. Bypass open or leaking; close or repair. 5. Internal parts damaged or broken; dismantle trap, repair.
Trap does not close	1. Trap too small for load; figure condensate quantity to be handled and put in correct-size trap. 2. Defective Mechanism holds trap open; repair. 3. Larger condensate load from (a) boiler foaming or priming, leaky steam coils, kettles or other units, or (b) greater process load; find cause of increased condensate flow and cure, or install larger trap. ***Note:*** Traps made to discharge continuously won't show these symptoms. Instead, the condensate line to trap overloads; water backs up.
Trap Blows Steam	1. Open or leaky bypass valve; close or repair. 2. Trap has lost prime; check for sudden or frequent drops in steam pressure. 3. Dirt or scale in trap; take apart and clean. 4. Inverted bucket trap too large, blows out seal; use smaller orifice or replace with smaller trap.
Capacity Failure	1. Inlet pressure too low; raise to trap rating, fit larger trap, change pressure parts or setting. 2. Back pressure too high; look for plugged return line, traps blowing steam into return, open bypass or plugged vent in return line. 3. Back pressure too low; raise.

Problem	Possible Cause/Cure
Condensate Won't Drain	System is air-bound; fit suitable vent or trap with larger air capacity to remove the air. 2. Steam pressure low; raise to the right value. 3. Condensate short-circuits; use a trap for each unit.
Low Heat From System	1. Defective thermostatic elements in radiator traps; remove, test, and replace damaged elements. 2. Boiler priming; reduce boiler-water level. If boiler foams, check fires and feed with fresh water while blowing down boiler at quarter-minute intervals. 3. Scored or out-of-round valve seat in trap; grind seat or replace old trap body with new one. 4. Vacuum pump runs continuously; look for a cracked radiator, split return main, cracked pipe fitting, or a loose union connection. Or pump shaft's packing may leak. 5. Too much water hammer in system; check drip-trap size. Undersized drip traps can't handle all condensate formed during warm-up so hammering results. Fit larger trap if drip lines are clean and scale-free. Size for warm-up load, not for load with mains hot. 6. System rundown; older heating plants are sometimes troublesome because a large number of trap elements are defective. Easiest cure is replacement of all thermostatic elements in the radiators. This is low-cost, sure.
Trap Freezes in Winter	1. Discharge line has long horizontal run where water collects Make discharge line as short as possible and pitch away from trap. 2. Trap and piping not insulated; fit insulation to outdoor from and piping connected to them.

Problem	Possible Cause/Cure
Backflow in Return Line	1. Trap below return main doesn't have right fittings; use check valve and a water seal, or both, depending on what the manufacturer recommends. 2. High-pressure traps discharge into a low-pressure returns flashing may cause high back pressure. Change piping to prevent return pressure from exceeding trap rating. 3. No cooling leg ahead of a thermostatic trap that drips a main; condensate may be too hot to allow trap to open right. Use a 4- to 6-ft cooling leg ahead of thermostatic traps on this vice. Fit strainer in cooling leg to keep solids out of trap.

		Causes for Indication of Malfunction	
Type of Trap	**Indicator of Normal Operation**	**Open**	**Closed**
Any Type of Trap	Should observe relatively high trap inlet temperature, but not superheat. Should observe flash on discharge to atmosphere and see normal characteristic discharge. Should hear normal, characteristic operation.	Excessive valve seat wear. Dirt on trap seat. Open bypass constantly blowing. Overloaded trap discharging continuously.	Temperature control valve throttles, insufficient steam pressure. Overloaded trap, backing up cold condensate. Clogging strainer. Closed stop valve upstream. Closed return line stop valve or check valve.
Thermostatic	Normal discharge-intermittent, or continuous depending on load, pressure, or type. Should see flash unless adjusted for sub-cooled operation. Should hear continuous or modulating flow. Should observe temperature near rated discharge temperature.	Thermal element failure (some types). Excessive backpressure (some types). Improper adjustments of setting. Worn valve or seal. Leaking gaskets. See above - Any Type of Trap.	Thermal element failed closed. Excessive backpressures (some types). See above - Any Type of Trap.

Type of Trap	Indicator of Normal Operation	Open	Closed
Inverted Bucket	Normal discharge intermittent can be continuous under some conditions of pressure and load. Should see flash. Should hear intermittent discharge possibly rattle of bucket, or bubbling of vent flow. Should observe relatively high inlet temperatures.	Loss of prime (low load, fluctuating pressure differences). Worn mechanism, valve or seat. Leaking internal seals/gaskets. See above-Any Type of Trap.	Dirt-plugged vent. Excessive differential pressure. Worn, oversized seat. Body filled with dirt. Air bound. See above-Any Type of Trap.
Disc	Normal discharge intermittent. Should see flash. Should hear intermittent discharge possibly clicking of disc on seat. Should observe relatively high inlet temperatures.	Worn seat, disc, or bonnet. Leaking internal seals/gaskets Excessive back pressure. See above-Any Type of Trap.	Installed backward. Air Bound. See above-Any Type of Trap.
Impulse Control Flow	Normal discharge-intermittent with continuous flow between discharges. Should hear continuous and intermittent flow. Should read relatively high inlet temperature.	Worn internals. Excessive backpressure. Condensate load too small. See above-Any Type of Trap.	Excessive wear in control cylinder. Excessive dirt in control orifice. See above-Any Type of Trap.

8.2.2 PMI 40-40-009 (Steam trap Preventive Maintenance and Repair), Support Services, provides maintenance procedure for Steam Traps.

9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained by FMU for steam traps to include, as a minimum, the parameters listed in the Table 9-1 below:

Table 9-1 Documentation Parameters

MAINTENANCE HISTORY DOCUMENTATION PARAMETERS				
PARAMETER	ML 1	ML 2	ML 3	ML 4
Maintenance Activities				
Repair / Adjustments	X	X		
PM Activities	X	X		
Trap Inventory	X	X	X	X
Equipment Problems				
Failure Dates	X	X		
Failure Root Cause	X	X		
Inspection /Testing				
Test Dates	X	X	X	X
SSC Condition	X	X		

Basis: Documentation of the parameters listed in Table 9-1 above satisfies the requirements of LPR 230-07-00, Criteria 2, (Ref. 10.5) which states; "Maintenance activities, equipment problems, and inspection and test results are documented."

10.0 REFERENCES

The following references, and associated revisions, were used in the development of this document.

10.1 LIR 230-05-01.0, Operations and Maintenance Manual.

10.2 DOE O 430.1A, Attachment 2 "Contractor Requirements Document" (Paragraph 2, Sections A through C), a requirement of Appendix G of the UC Contract.

10.3 DOE Order 4330.4B, Maintenance Management Program, Section 3.4.9.

10.4 LIR 301-00-02.0, Variances and Exceptions to Laboratory Operations Requirements.

10.5 LPR 230-07-00, Maintenance History, Performance Criteria [2].

10.6 LIR 230-04-01.1, Laboratory Maintenance Management Program

10.7 Spirax Sarco Steam Utilization Handbook, Federal Energy Management Program Newsletter

10.8 Managing Steam, Edited by Jason Makansi (Reference 10.8)

11.0 APPENDICES

Appendix A - Steam Trap Start-Up
Appendix B - Steam Trap Selection

APPENDIX A

STEAM TRAP START-UP

Supervised Start-Up

$$\frac{\underset{\text{Warmup Load (lbs/100 ft)}}{\boxed{}} \times \underset{\text{Main Length (100 ft)}}{\boxed{}} \times \underset{\text{Safety Factor}}{\boxed{}}}{\underset{\text{Insulation Factor}}{\boxed{}}} = \underset{\text{Condensate Load (lbs/hr)}}{\boxed{}}$$

Steam Trap Sizing Safety Factors

Type of Trap	Safety Factor
Balanced-Pressure	2 to 4
Bimetallic	2 to 4
Liquid-Expansion	2 to 4
Float & Thermostatic	1.5 to 2.5
Inverted Bucket	2 to 3
Disc	1.2 to 2

Steam Condensate Warm-Up Load

Steam Pressure (psig)	Warm-Up Load (lbs/100 feet of steam main)														0°F Correction Factor
	Steam Main Size														
	2"	2.5"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"	
0	6.2	9.7	12.8	18.2	24.6	31.9	48	68	90	107	140	176	207	308	1.50
5	6.9	11.0	14.4	20.4	27.7	35.9	48	77	101	120	157	198	233	324	1.44
10	7.5	11.8	15.5	22.0	29.9	38.8	58	83	109	130	169	213	251	350	1.41
20	8.4	13.4	17.5	24.9	33.8	43.9	66	93	124	146	191	241	284	396	1.37
40	9.9	15.8	20.6	29.3	39.7	51.6	78	110	145	172	225	284	334	465	1.32
60	11.0	17.5	22.9	32.6	44.2	57.3	86	122	162	192	250	316	372	518	1.29
80	12.0	19.0	24.9	35.3	47.9	62.1	93	132	175	208	271	342	403	561	1.27
100	12.8	20.3	26.6	37.8	51.2	66.5	100	142	188	222	290	366	431	600	1.26
125	13.7	21.7	28.4	40.4	54.8	71.1	107	152	200	238	310	391	461	642	1.25
150	14.5	23.0	30.0	42.8	58.0	75.2	113	160	212	251	328	414	487	679	1.24
175	15.3	24.2	31.7	45.1	61.2	79.4	119	169	224	265	347	437	514	716	1.23
200	16.0	25.3	33.1	47.1	63.8	82.8	125	177	234	277	362	456	537	748	1.22
250	17.2	27.3	35.8	50.8	68.9	89.4	134	191	252	299	390	492	579	807	1.21
300	25.0	38.3	51.3	74.8	104	143	217	322	443	531	682	854	1,045	1,182	1.20
400	27.8	42.6	57.1	83.2	116	159	241	358	493	590	759	971	1,163	1,650	1.18
500	30.2	46.3	62.1	90.5	126	173	262	389	535	642	825	1,033	1,263	1,793	1.17
600	32.7	50.1	67.1	97.9	136	187	284	421	579	694	893	1,118	1,367	1,939	1.16

Loads based on an ambient temperature of 70°F. For an outdoor temperature of 0°F, multiply the load values by the 0°F correction factor for that pressure.
Schedule 40 pipe used through 250 psig. Values for pressures over 250 psig are for Schedule 80 pipe.

APPENDIX B

STEAM TRAP SELECTION

Steam Trap Selection

There are three general classifications of steam traps: thermostatic, mechanical, and thermodynamic. Within each classification are a number of different types of traps. Since the principles of operation of each trap type differ, each is best suited for particular applications that impose certain conditions on the trap and how it is expected to perform. There is no one universal trap suited for all applications.

Most common trap types, their characteristics, and typical applications are as follows:

> **Thermostatic traps**- Differentiate between steam and condensate by their temperatures. Condensate is typically cooler that steam, although in some systems, the temperature difference may be hard to detect. The thermostatic trap is designed to sense when cooler condensate is present and open, allowing it to pass. As soon as it comes in contact with the hotter steam, the trap closes.
>
> **Mechanical traps** -Differentiate between steam and condensate by their density. The higher density condensate causes a mechanism, such as a float, to lift, opening a valve to pass the condensate. Once the condensate has been removed, the lower density steam cannot support the float, so it falls, closing the valve.
>
> **Thermodynamic traps** -Differentiate between steam and condensate by their different velocities in the system. Steam, which has a higher velocity than condensate, exerts enough pressure on a disc valve to force it closed. Lower velocity condensate does not exert enough pressure so the disc opens, allowing the condensate to escape from the system.

Caution: Don't simply replace a failed trap with a new unit of the same type and size. The trap may have failed, in part, as the result of trying to use the wrong type of trap in that particular application.

Basis: "Managing Steam", Edited by Jason Makansi (Ref 10.8)